A Study of Mercury Bioaccumulation in River Ecosystems

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USGS Collaborators

- NAWQA (National Water-Quality Assessment Program)
- Toxics Program
- National Research Program
- Multi-discipline:
  - Water, Biology, Geology

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Mercury Concerns

- Widespread (global) and highly toxic
- Many forms; bacteria can convert these forms to methylmercury
- Methylmercury is bioaccumulated by all aquatic organisms
- Methylmercury is biomagnified
- Potentially serious human-health effects

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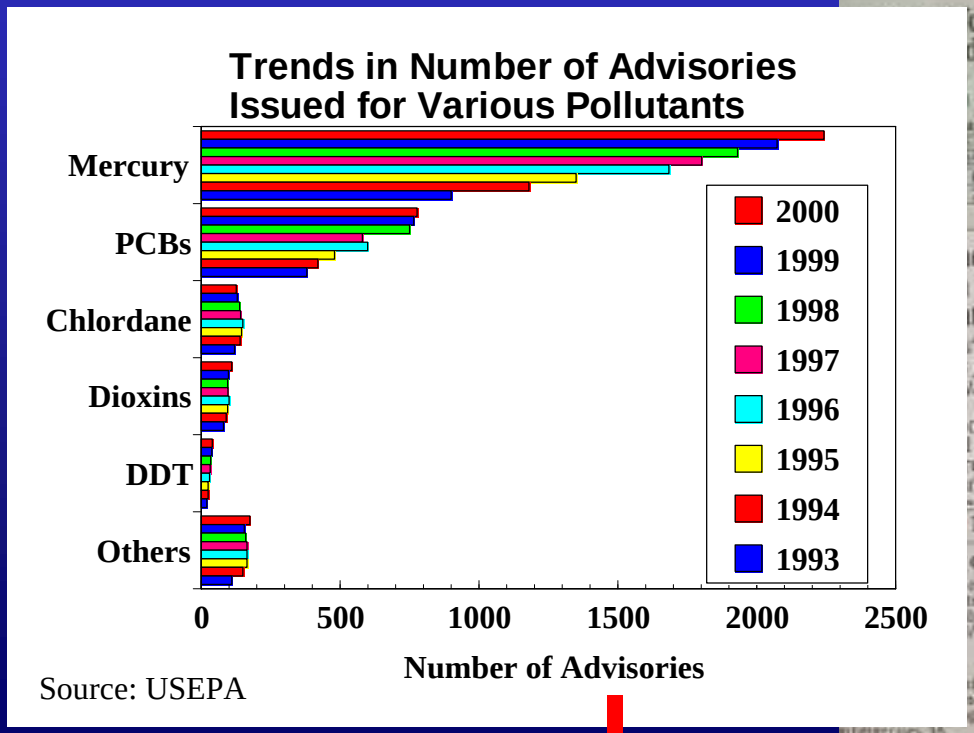
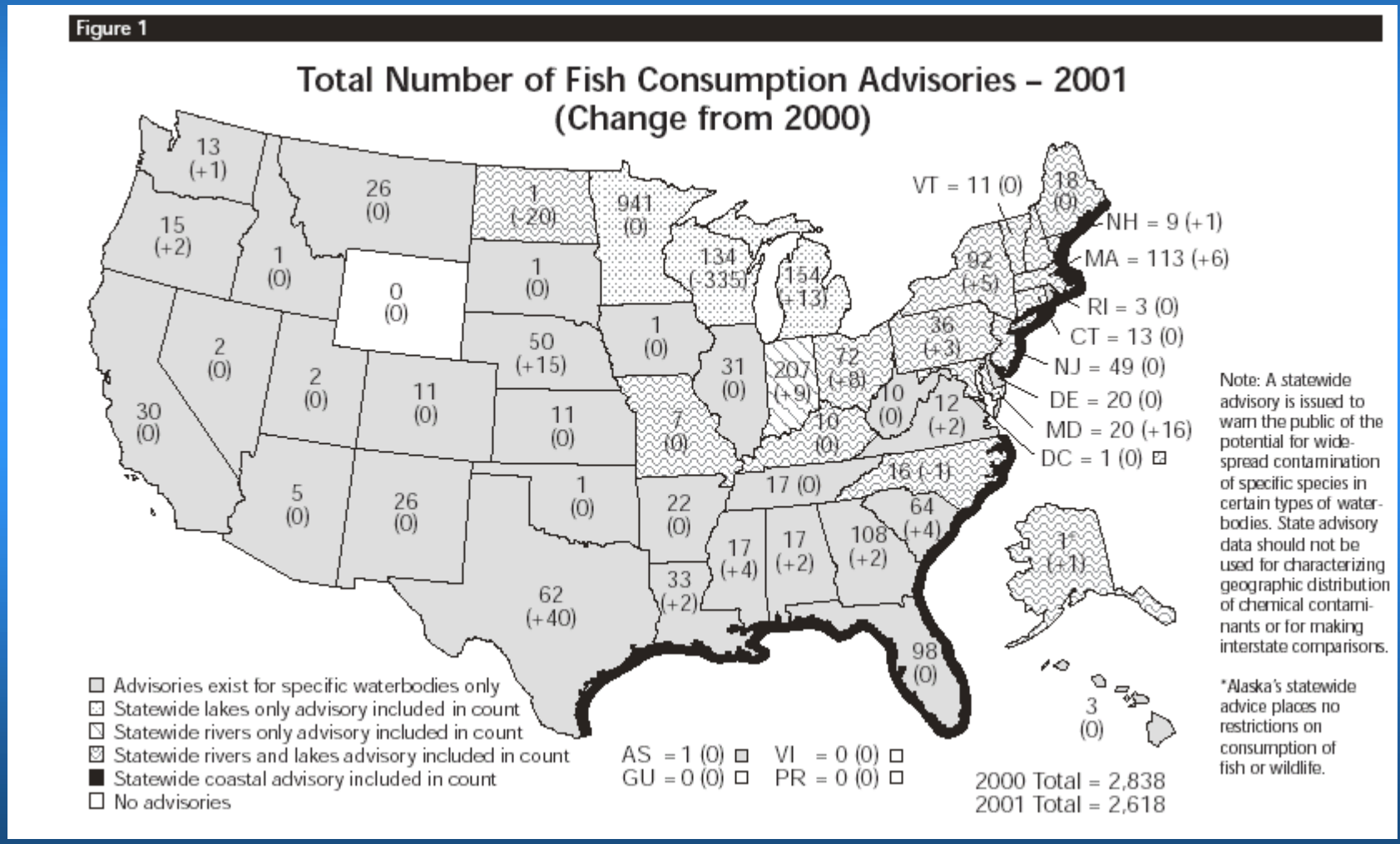
Mercury is by far the leading cause for contaminant-related, human-health advisories in the US



Source: USEPA

Fish-consumption advisories exist in 40 states and account for 79% of all such advisories in the Nation (USEPA, 2001)



General Objective

- Determine the effects of source strength, methylation efficiency, and food-web interactions (food-web complexity) on bioaccumulation of mercury in fish in stream ecosystems

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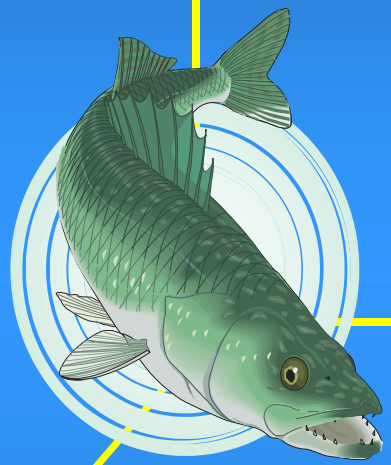
Factors in Mercury Bioaccumulation

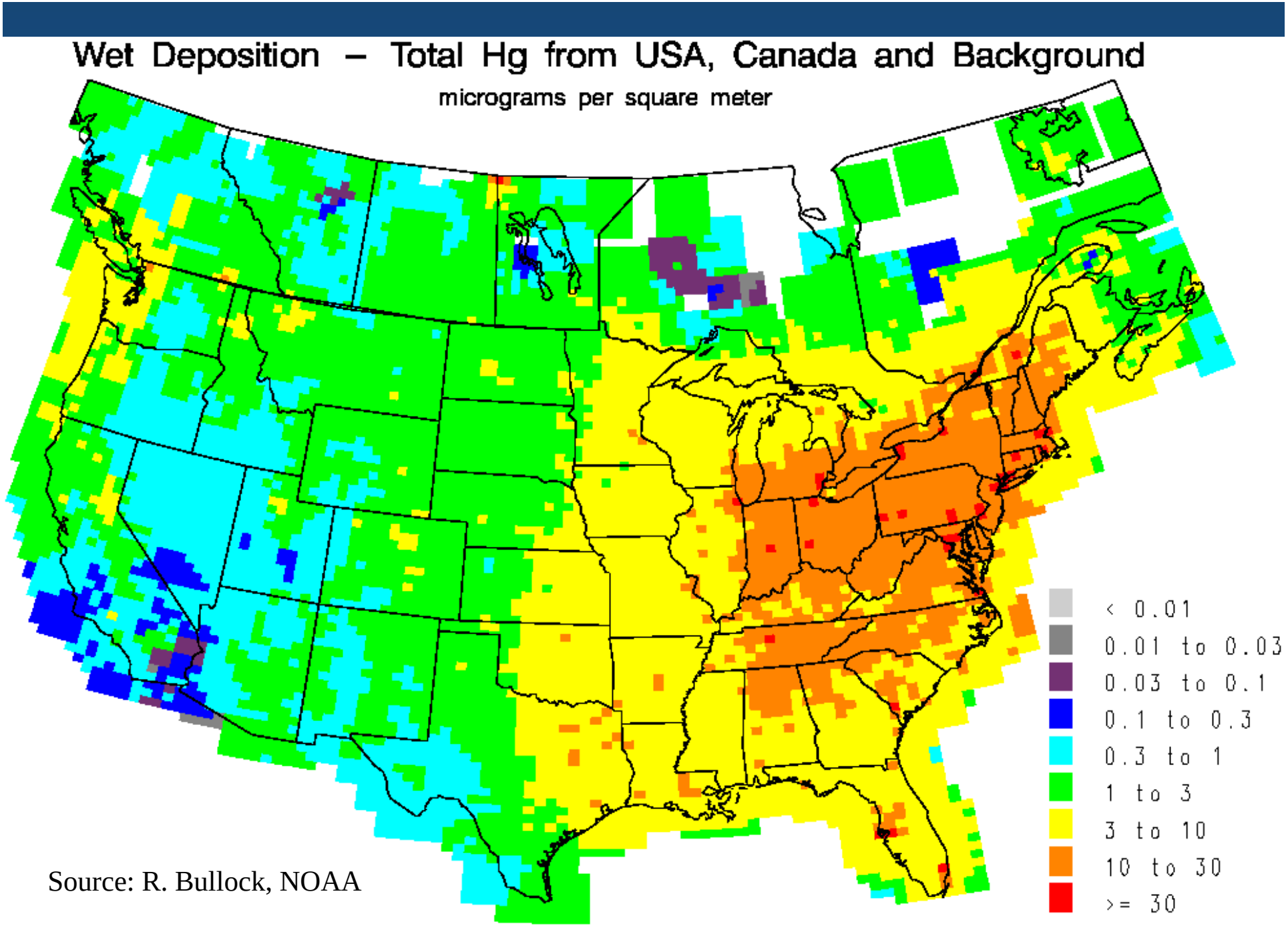


Mercury source strength

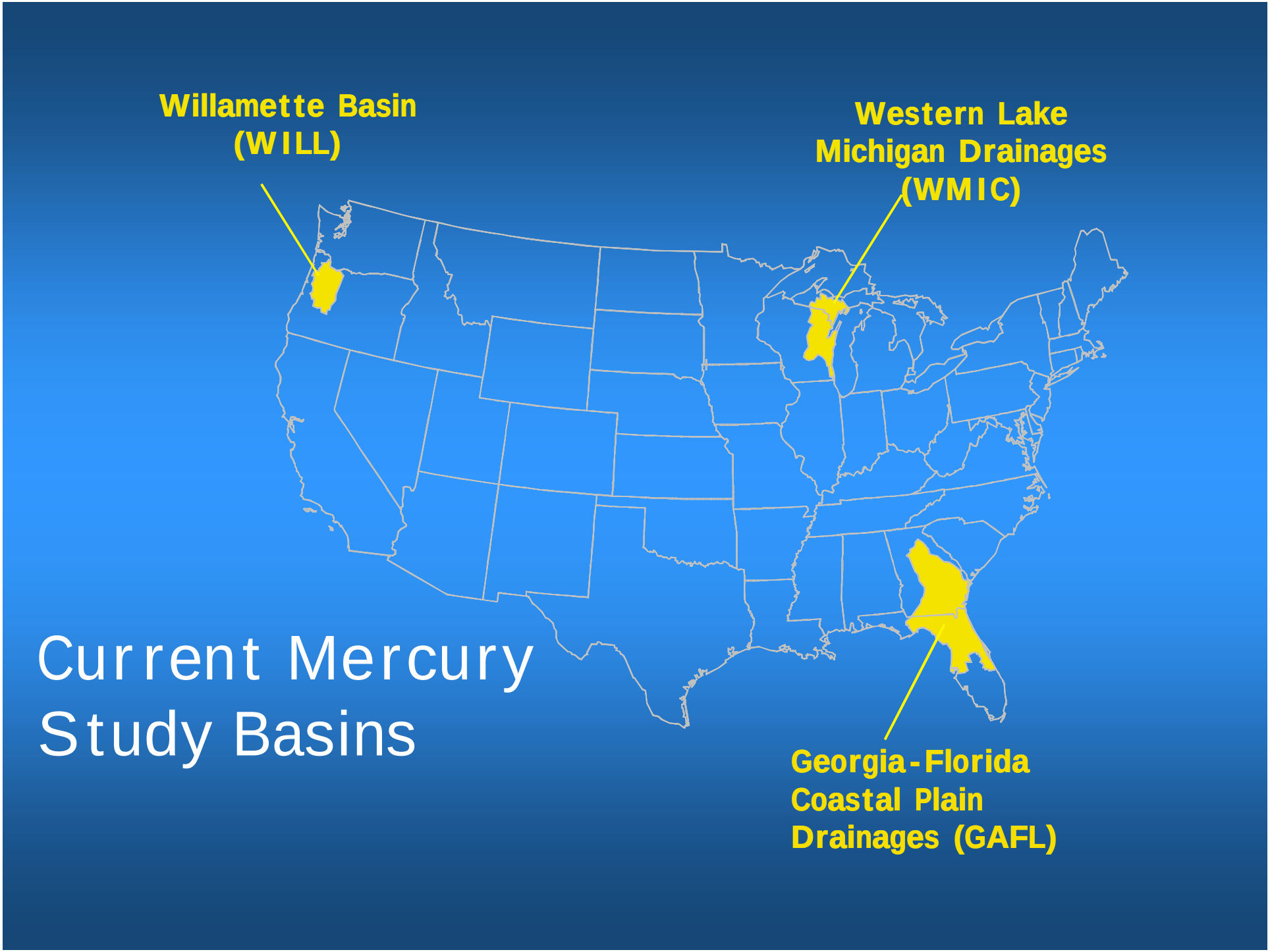
Food chain complexity

Methylation efficiency

After T.E. Mumley and K.E. Abu-Saba, in press.



Source: R. Bullock, NOAA



Current Mercury Study Basins

Approach - Site Selection

- 3 Sites per NAWQA Study Basin
- Mercury landscape type
  - 1 Urban
  - 2 Rural/non-cultivated (low/high % wetland)
- USGS gaged streams
- Availability of target species
- Range of food web complexity

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Approach – Multi-media

- Water: 18x yr, 2 years (2003-4)
  - Dissolved and Particulate THg and MeHg
  - DOC, Sulfate, Suspended sediment
  - Stable isotopes of particulate organic matter
- Sediment: 2x yr, 2 years (2003-4)
  - THg and MeHg
  - Acid-volatile sulfide
  - Microbial methylation efficiency
  - Stable isotopes (δ13C, δ15N)
- Biota: 1 year (2003 only)
  - THg (fish); THg and MeHg (inverts only)
  - Stable isotopes (δ13C, δ15N)

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Determine the influence of food-web complexity on mercury contamination in top predator fish

- How does food-chain length (# of steps between base of food web and apical fish) affect mercury concentrations in fish in diverse stream ecosystems?

- What is the influence of specific differences in food-web structure (e.g., food sources, species type, and habitat utilization) on mercury bioaccumulation?

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Top Predators

Secondary Consumers

Primary Consumers

Primary Producers /Detritus

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Top Predators

Sample Once
2 species
6 individuals each
Fillets (skin-off)
Length, weight
THg
$\delta^{13}C$, $\delta^{15}N$

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Food Organisms

Forage Fish

Sample twice
2 species
6 individuals each
Whole body
Length, weight
THg
$\delta^{13}C$, $\delta^{15}N$

Benthic Invertebrates

Sample twice
2 species
Triplicate composites of > 30
THg and MeHg
$\delta^{13}C$, $\delta^{15}N$

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